MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2018/2019

EME 2066 – MEASUREMENT AND INSTRUMENTATION

(ME)

29 MAY 2019
9.00 a.m.–11.00 a.m.
(2 Hours-OPEN BOOK EXAMINATION)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 4 pages including cover page with 4 Questions only.

2. Attempt **ALL** questions. All questions carry equal marks.The distribution of the marks for parts of each question is shown.

3. Please write all your answers in the Answer Booklet provided.

4. This is an **OPEN BOOK** examination. The book allowed is, " Experimental Methods for Engineers" by J.P.HOLMAN, McGraw Hill Publication, 8th Edition (***only printed book is allowed***).

5. Please refer to the above book for any additional data required.

QUESTION 1

a) A transducer operating as a second order system is to be used to measure a signal at 500 Hz. The natural frequency of the transducer is 1000 Hz. Determine the damping ratio c/c_0 to be selected so that the amplitude ratio is 0.95. **[6 marks]**

b) The power in a circuit is given by $P = VI$. If V=230 V ± 5% and I=5 A ± 3%, Calculate the nominal value of power and its uncertainty. **[6 marks]**

c) A laboratory experiment was conducted to measure the viscosity of certain oil. A series of tests gave the following values:

S.No	1	2	3	4	5	6	7	8
Values (ft^2/s)	0.040	0.041	0.042	0.039	0.040	0.043	0.041	0.038

Calculate the mean, the variance and the standard deviation. Identify any bad data point using Chauvenet's criterion. **[9 marks]**

d) A search coil is used to measure the flux density in a magnetic field. The coil has a nominal area of 1 cm^2 with 50 turns of wire. The rotational speed is 150 rpm. The output voltage was 30 mV. Determine the flux density of the magnetic field. **[4 marks]**

QUESTION 2

a) A U-tube manometer uses mercury as the manometer fluid to measure a differential pressure in water at 80°F (density 996 kg/m^3). Both sides of the manometer have diameters of 4.5 mm.

i. If the difference in heights of the two columns is 15 cm, find the differential pressure in Pascals. **[4 marks]**

ii. If the manometer had unequal diameters of 4.5 and 9mm, what pressure differential would be indicated if the 15cm measurement is the height of the small column form zero level instead of the heights difference of the two column?. **[3 marks]**

b) A Bridgeman gage is employed for measurement of pressure using a Manganin element which has a resistance of 90 Ω at 1 atm. Calculate the resistance of the gage under a high pressure of 700 atm. **[5 marks]**

Continued....

c) Water at 60°C flows in a 7.5 cm diameter pipe at a mean flow velocity of 8 m/s. Calculate the flow rate in units of kg/s, lbm/min, gal/min and litre/s. **[5 marks]**

d) A pitot tube is used to measure the velocity of an airstream at 20°C and 1 atm.

i. If the velocity is 2.5 m/s, calculate the dynamic pressure in newton's per square meter. **[3 marks]**

ii. What is the uncertainty of the velocity measurement if the dynamic pressure is measured with a manometer having and uncertainty of 5 Pa. **[5 marks]**

QUESTION 3

a) A bimetallic strip is constructed of strips of Yellow Brass and Monel 400 bonded together at 20°C. Each has the thickness of 0.5 mm. Calculate the radius of curvature and length of deflection when a 4 inch strip is subjected to 80°C. **[12 marks]**

b) A capillary tube apparatus is to be used for measuring viscosities of oils with υ=0.001 m^2/s and ρ=890 kg/m^3. The design Reynolds number is 5. Calculate the length of a 1.0 cm diameter tube which will produce a pressure drop of 40 kPa. **[8 marks]**

c) A Saybolt viscometer is used to measure the viscosity of a certain oil. The time for drainage of the standard 60 mL sample is 140± 1s. Calculate the dynamic viscosity of the oil in units of kg/m.s if the density is 880 kg/m^3. **[5 marks]**

Continued....

QUESTION 4

a) A torque sensing element is made of a hollow cylinder as shown in **Figure 4**. The dimensions are r_i = 2.5 cm, r_0=3.2 cm, L=15 cm.

i. Calculate the angular deflection for an applied moment of 22.6 Nm.

[3 marks]

ii. Calculate the strain that would indicated by the gages attached.

[2 marks]

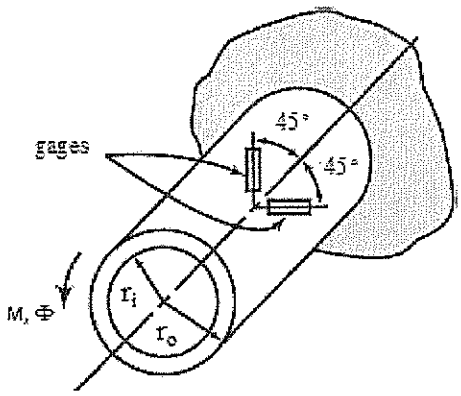

Figure 4

b) The torque of a certain engine is 540 Nm at 3000rpm. Calculate the power required to test this engine and express the answer in both kilowatts and hp.

[5 marks]

c) A 2 cm diameter rod, 60 cm long, is subjected to an axial load and the strain measured with the gage factor is 1.7. The voltage source is 4.5V.

i. Calculate the axial force in Newton would be necessary to produce an axial deformation of 11μm, assuming that the young's modulus of steel is 28.3×10^6 psi.

[9 marks]

ii. Determine the resulting gage reading in volts. **[6 marks]**

End of paper